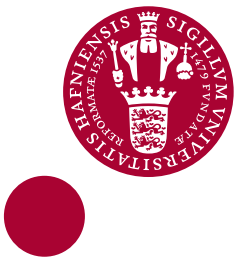

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The Good Sperm Cell
Ethnographic Explorations of Semen Quality

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Abstract: In this article, we compare the meaning and assessment of semen quality across three different contexts: male infertility, sperm donation, and in-vitro sperm. We ask how semen quality is determined in these three contexts and what kind of practices and normative choices these evaluative processes involve. While the notion of good semen quality is often reduced to biomedical evidence, our analysis shows that it also draws on beliefs about what is desirable and what is not, producing biomedical evidence in light of specifically desired outcomes. Unpacking semen quality, by looking at the specificities of how it is done across three different contexts, in this article we thus move beyond comprehending quality standards as purely technical matters and reposition biomedical assessments of male reproductive potential in their political and normative contexts.

Keywords: artificial sperm cells; gender; infertility; masculinity; reproductive biomedicine.

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1. Introduction

Julia and I are alone in the laboratory. It is Thursday afternoon, and even though it has not been a slow day at the sperm bank, it is a lot quieter now than it was before lunch, quiet enough for Julia to find the time to calibrate the counting chambers which are used to count sperm cells. She is telling me stories about some of the sperm bank's clients she has to deal with, when Aaliyah walks in. Aaliyah is the donor coordinator at the bank and responsible for scheduling donors for their interviews and check-ups. As she tells Julia and me, the donor candidate waiting at the front desk had shown up too late for his appointment: "Why do they do that", she says frustrated. It would be hard enough to schedule all the

interviews in the first place. "But, he is very cute", she adds right away and Julia and I tilt our heads in order to get a glimpse of him through the laboratory window. Julia and I agree: he is very cute. Aaliyah doesn't know what to do with the donor though, since his first sperm count had turned out to be too low, "only 76". Normally, donor candidates need to have a count of 200 in order to be considered. "Well, you know, the quality of samples varies a lot", says Julia to Aaliyah. She had a donor once who just needed to wait longer in between ejaculations in order for his quality to improve. To start with, his samples were not good quality, even at an interval of 70 hours in between ejaculates: "But then I had him wait for 100 hours and what do you know, the quality was perfect." Maybe this candidate has a chance after all. Aaliyah agrees: "Okay, I will let him donate today and if it is good enough I reschedule him for an interview." (Excerpt from fieldnotes)

Quality assessments of semen are, in part, a technical matter. Semen samples are weighed, their pH-value measured, their viscosity categorized, and the number of sperm cells counted. As such, semen analysis has become a science. However, this scientific expertise is plagued by uncertainties: how many sperm cells need to be positively evaluated in order for a man to be classified as fertile? How much semen fluid needs to be tested in order to give a valid answer? How motile is motile enough for 'normal' reproduction? Does a crooked tail or a 'pretty' head say anything about a sperm cell's ability to merge with an egg cell? In principle, just one viable sperm and egg cell are enough to produce a child. Yet while technology can be used to assess a man's and his semen's reproductive potential, the determination of a threshold will always rely on an interpretation of that assessment. Furthermore, as the introductory fieldnote from fieldwork at an American subsidiary of a Danish sperm bank illustrates, quality assessments of semen include non-technical matters as well. Values such as attractiveness or the 'cuteness-factor' of donor candidates as well as their reliability to show up for appointments on time can become part of 'semen quality' and thus influence decisions about whether men's semen will be accepted by a sperm bank.

Evaluations of quality as part of reproductive medicine include normative claims and understanding these claims is important since they, as Ayo Wahlberg puts it, enable assessments of which life is worth living (Wahlberg 2008; 2010). This article explores the concept of "semen quality" in the context of reproductive biomedicine. In particular, we are concerned with how assessments of semen quality become imbued with certain values and how these assessments are used to make decisions about reproductive futures. Our analysis concerns three different contexts: assessments of semen quality at a male fertility clinic, the concept of good semen quality at sperm banks, and definitions of good quality at a research lab for artificial sperm cells, so called in-vitro sperm. The entanglement of quality measurements with social values and reproductive visions in these three distinct settings shows how semen quality is far from being inherent to semen itself. Rather, semen quality represents a particular techno-scientific configuration of semen depending on the context in

which semen is assessed. Comparing the assessment of semen quality across three contexts we thus show how biomedical judgements about good semen quality are highly normative decisions rather than simply matters of technical precision.

We begin with a short discussion of perspectives on semen from within the social sciences which provide the background for our own analytical approach. Thereafter we attend to how semen quality is construed as a political and medical problem in public debates in Denmark and in andrological literature. This provides a backdrop for the subsequent analysis and comparison of concrete practices of semen quality assessments at a male fertility clinic in Denmark where subreproductive semen is analyzed, the selection of sperm donors based on semen quality at Danish sperm banks, as well as quality assessments in experiments with in-vitro sperm cells in Germany. In conclusion, we will offer remarks on what good quality semen means in these different situations and how that relates to norms of reproduction.

The fieldwork that provides the empirical context of our analysis was carried out between 2011 and 2014 and is part of Sebastian Mohr's doctoral research on sperm donation and sperm donors in Denmark (Mohr 2014; 2015; 2016a; 2016b; 2018). Fieldwork included participant observation at a large clinical research and medical treatment centre for reproduction and fertility in Denmark as well as at Danish sperm banks and their American subsidiaries and semi-structured interviews with two researchers developing new modes of producing male germ cells in-vitro, that is, outside the male body, at a German institute for human genetics. What connects these different contexts, beyond their interest in semen quality, is their international orientation in regard to concrete working practices and ways of knowing and valuing under the umbrella term (male) reproductive biomedicine. Thus while each empirical site represents an individual organizational unit, they are nonetheless connected by a shared investment into what Marica Inhorn has termed "reproscape", that is, a global biomedical "meta-scape […] traversed by global flows of reproductive actors, technologies, body parts, money, and reproductive imaginaries." (Inhorn 2011, 90). Passages from interviews and field journals were translated to English from their original German or Danish. All informants appear under pseudonyms.

2. Studying Semen: From Discourse to Materiality

Semen has fascinated human kind for a quite a while. At least since Antonie van Leeuwenhoek examined sperm cells under a microscope in the middle of the 17th century, semen has been interrogated again and again. Preceding the relatively recent social science interest in semen as part of reproductive technologies (Martin 1991; Daniels 2006; Moore 2008; Adrian 2010; Almeling 2011; Émon 2012; Mohr 2016a), social sci-

entists though have primarily focused on semen's cultural role (Herdt 1987; Allen 1998). Inspired by a symbolic reading of the body (Douglas 2010), this research understands semen to be part of a symbolic system with which people orient themselves in the world pointing to the central role of ideas about semen in gender and kinship norms.

As Antje Kampf points out, the need to understand the physiological characteristics of semen grew tremendously after World War Two (Kampf 2013), with infertility gaining attention as a recognized pathology in need of therapy. The subsequent success of reproductive biomedicine after the introduction of IVF sparked an interest in the social sciences for the social dynamics of reproductive biomedicine (Franklin and McNeil 1988). This coincided with the so called *materialist turn* in the social sciences as a result of which social scientists turned their attention to the production of biological facts and materialities. In particular feminists such as Emily Martin (1991) or Donna Haraway (1991) for example engaged with so called biological facts, revealing ways in which these facts are embedded in the performative realm of gendered social life.

The assessment of cell's characteristics in particular can be understood as not only technologically and culturally mediated understandings of what 'cells' are and do, rather they also reflect the human quest to gain control over reproduction (Clarke 1998; Svendsen and Koch 2008). In their work on the selection and assessment of embryos at a Danish fertility clinic, Mette Nordahl Svendsen and Lene Koch show that work at the biomedical lab is embedded in moral landscapes understood as terrains of agency which are "continually recreated in relation to organizational relations, research protocols, techno-scientific objects, clinical classifications and notions of professional responsibility." (Svendsen and Koch 2008, 106). Likewise, when semen quality is assessed, scientists and lab technicians are not only "doing" cells. They are also re-enacting norms which revolve around what it means to be human and not least what relations certain gendered individuals should have with one another. Thus while the claim to scientific objectivity engrained into biomedical sciences certainly has a particular history (Daston and Galison 2007), the understanding of semen as a pure male liquid that gives new life its form so important for reproductive biomedicine, also has a longer genealogy as Murat Aydemir shows (Aydemir 2007). This understanding leads back to ancient Greece and Aristotle's conceptualization of the role of men in the creation of life which holds that men pass on certain social characteristics with their semen. This notion is still relevant today when for example sperm donors are selected not only according to their sperm count but also because of certain characteristics thought of as transferable to the child (Daniels and Golden 2004; Mohr 2016a). This potency of semen also plays into religious imaginaries of human-deity relationships as Amy DeRogatis (2009) shows (DeRogatis 2009). Here semen either becomes God's tool to punish sins with sexually transmitted diseases or takes on a

metaphorical meaning in the form of the word of God entering the body as healing sperm.

These examples from a larger body of scholarly work on the meanings of semen (Tober 2001; Blaagaard 2006; Kilshaw 2007; Shand 2007; Kroløkke 2009; Lie et al. 2011) draw attention to the ways in which the meaning and actions of semen are dependent on networks in which it circulates. Semen is never alone, even as a single cell under a microscope. However, most of this literature has focused on the ways in which semen is represented, and on the social implications of networks that enable the exchange of semen. The clinical tests and procedures themselves however, which determine whether a semen sample is used or discarded, and whether a man can become a sperm donor or is likely to become a father, have not received a lot of attention. This article addresses this gap, focusing on the production of quality in the assessment of semen.

Since in the clinical domain, the potentials ascribed to semen and the ways in which samples are used and patients treated are often determined via a measurement of semen quality, we use *quality* as our analytical object in order to understand the norms and values that are incorporated in clinical and laboratory practice. By understanding how quality is determined, one can better comprehend the characteristics of those norms which are entrenched in biomedical rationalities, yet which are rarely acknowledged as particular ethical, social, and political choices.

3. Semen Quality as a Sociopolitical and Medical Problem

Throughout the past decade, Danish men's semen quality has been monitored and debated regularly, with falling numbers of semen quality giving rise to a notion of a fertility crisis (Andersen et al. 2000; Jørgensen et al. 2006; Aggerholm et al. 2008; Jørgensen et al. 2011). In May 2011, the Danish Health Authority Sundhedsstyrelsen published a minute that concluded that Danish men's semen quality was actually not as low as previously believed (Bredsdorff 2011). The researchers responsible for the data behind this minute were not consulted prior to its release and, subsequently, Danish and international researchers reacted with much anger because they had interpreted the data differently than the Danish Health Authority. Whilst there is a shared understanding between these two parties that measurements of semen quality are necessary and important, there seems to be no agreement upon how to conduct and interpret such measurements. Some researchers are even convinced that the data used to determine whether semen quality has fallen or risen during the past 15 years is too heterogeneous (methodically, ethnically, and geographically) to conclude anything at all (Merzenich et al. 2010).

From a broader social science perspective, the interest in semen quality and attempts to measure and compare it on a national and even international level, seems to reflect a social fear that Danish men are losing

their fertility, threatening a bright reproductive future. As Lisa Jean Moore has argued echoing much of the work outlined above, any discussion about semen quality should be situated within a much wider discourse about the crisis of masculinity within western societies (Moore 2008). That is to say that the term 'semen quality' and the ways it is understood, measured, and mobilized are not only connected to specific material qualities of sperm cells, but also to our understanding of the role of men, both within reproduction and more generally as part of a heteronormative society. In this context having bad semen quality is potentially connected to being seen – and understanding oneself – as a man of lesser quality (Birenbaum-Carmeli and Inhorn 2009; Goldberg 2010).

Public discussions about semen quality are characterized by a very vague understanding of what semen quality actually is and what it refers to. Even in andrological textbooks the term's meaning is most of the time assumed rather than explicated. Semen quality can be understood as a measurement of the ability of sperm cells to fertilize an egg cell. Arising out of the andrological literature on semen quality, this definition reifies gender stereotypes by assigning the role of the passive and awaiting part to the egg cell (Martin 1991). Alternatively, semen quality could be defined as a measurement of the ability of sperm cells to merge/fuse with an egg cell. More importantly, however, both these definitions point to the end result of a process, rather than a measurable parameter inherent to sperm cells itself. Indeed, a clear definition of which semen parameters 'quality' actually refers to is almost always missing from chapters in andrological reference books. Instead, these books define semen quality implicitly through the evaluation of a set of characteristics acting as proxies for desired end results (Kvist and Björndahl 2002; Björndahl 2010; Cooper 2010)[1].

A number of different parameters have been identified as being important for a sperm cell's capacity to reach an egg cell and fuse with it into a zygote: semen's smell, texture, and volume; the number of sperm cells, their vitality, and tendency to stick to one another; the individual sperm cell's appearance and morphology; and the concentration of sperm cells within the ejaculate. Semen analysis is the process by which these parameters are identified, an established and relatively low-tech laboratory practice. Semen quality is used to argue for or against a certain medical intervention in men's bodies and lifestyles when they undergo so called fertility treatment[2], but also as a point of reference for public health guidelines with regard to national and international reproductive trends. Yet, as British andrologist Allen Pacey (2009) puts it, the assessment of semen quality is not an exact science. After the World Health Organization (WHO) had published a new manual for examining and processing semen in 2010, it was discussed very critically within andrological circles (Handelsman and Cooper 2010; Jequier 2010), especially in relation to the WHO's much-contested definition of normal fertility (Joffe 2010).

Adding to the difficulties with defining and conducting precise measurements of semen quality, most andrologists believe that quality is not stable over time, or across contexts. Sexual arousal (Pound et al. 2002), environmental pollution (Jurewicz et al. 2009), work environments and lifestyle (Collodel et al. 2008; Sharpe 2010), and situations of deep crisis such as war (Abu-Musa et al. 2011), all seem to affect semen quality. Yet even with the awareness that semen analysis has intrinsic limitations, the search for more accurate and objective ways of measuring semen quality continues. The introduction of computer based semen analysis (CASA) in the 1980s and its continued development (Vested et al. 2011) as well as the growing influence of DNA based methods of analysis (Lewis and Agbaje 2008) are examples of this. The attempt to find a more objective way of measuring semen quality can never fully do away with the fact that measurements embody norms, and that the semen samples which are measured are influenced by subjective circumstances such as sexual arousal. In other words, the longing for objectivity does not do away with subjectivity. The evaluation and assessment of semen is embedded in a dynamic field of scientific requirements and claims, cultural systems of meaning, and individual fate. This also means that quality is an ambiguous concept whose actual meaning is played out in practice, and it is to this practice that we now turn, beginning in a clinic for male infertility.

4. Male Infertility: Semen Quality as Minimum Goal

In the clinic, efforts revolve around a simple goal: conception. When men are treated for infertility as a consequence of subreproductive semen, semen thus does not need to be excellent in order to qualify as 'good enough'. Rather, good quality sperm cells are cells which have the potential to reach an egg cell despite particular deficiencies. This premise frames what standards for assessing semen quality in this context looks like: the goal is to find a basis from which to decide whether a man, and implicitly a couple, should receive treatment in order to become (a) parent(s). In other words, the quality assessments of subreproductive semen have a treatment objective. At the same time, measuring semen quality in this setting involves a number of different approximations and choices of what to measure as a proxy for that which one actually wants to look at but cannot examine directly: the capacity of sperm cells to move in a particular woman's body and fuse with that woman's egg cell.

The treatment centre for male infertility where fieldwork was undertaken is situated in a large hospital in Denmark and combines clinical treatment with a research centre. Analyzing semen samples of men with fertility problems is therefore only one of many different procedures carried out by the staff and researchers. Semen analysis takes place in a special laboratory separated from other parts of the treatment centre and combines many different tests and procedures: weighing semen samples;

evaluation of their texture and pH-value; measuring motility (capacity to move) and concentration of sperm cells in the samples; testing sperm cells' penetration strength and their reaction to anti-bodies and assessments of sperm cells' morphology (cells' physical appearance). A lab manual describes the procedures for conducting each test. These guidelines broadly follow the manual for semen analysis published by the WHO (Cooper 2010) but also differ in certain details. For example, the WHO manual recommends counting 200 spermatozoa twice when assessing a semen sample's motility, whereas the lab manual specifies counting only 100 sperm cells twice. Standards for semen analysis are not fixed but continuously adapt to local practices. Counting only 100 spermatozoa instead of 200 as recommended by WHO does not make the Danish lab's test results less reliable since counting 200 sperm cells is just as imprecise as counting 100. In both instances, only a tiny part of the semen sample is being tested (0,00003 %) with a single semen sample potentially having between 40 and 600 million sperm cells.

The laboratory staff is aware that their work encompasses these approximations. One of the bio-analysts talked about how, at the beginning of her professional training, she tried to count every single sperm cell every time she looked through the microscope. She thought counting every cell would be more correct than just counting 100. But that was, as she phrased it, "an illusion": certainty about a man's fertility cannot be reached even when all cells are counted. In line with the bio-analyst's reflection, manuals for semen analysis point out that semen analysis is not a definitive answer to the question of whether a man can father children or not. Rather, semen analysis is an approximation that supports a decision for or against a treatment plan. Or in other words, measurement practices develop performative effects: they not only describe a certain version of reality but create one in the sense of determining what treatment will look like and how people will perceive of themselves (*Am I man enough? Can we become parents?*).

One of the ways in which semen quality is assessed at the treatment centre is a so-called penetration test. This test's objective is to test sperm cells' capacity to move and penetrate. As part of this test, sperm cells are placed within egg whites to test their ability to move. Thus, in effect, egg whites stand in for the female body, chosen based on their similarity to vaginal mucus. Their ability to perform this role is tested by using sperm cells that have been declared to be motile in other egg whites. The test is thus based on a model as part of which two actors are used to validate each other's reproductive capacity. Whether sperm cells will perform well or not during this test, contributing to the kind of quality assessment a specific semen sample will receive, and thus what kind of treatment patients will be offered, is in other words due to the characteristics of egg whites and laboratory conditions as well as to sperm cell's own capacities.

In practice, the dynamic relationship between different actors (laboratory staff, egg whites, glass tubes, sperm cells) during the test looks as follows:

Maria is looking at the first sample under the microscope and after a few seconds she says: "One thing is for sure, these ones did not make it very far. And I also knew that beforehand." When analyzing the penetration test, Maria looks at how far sperm cells have moved within the tubes containing the egg white (which are called micro capillary tubes). In order to find out how far the sperm cells have advanced, she looks at the first tube and searches for sperm cells in its upper part (farthest away from where the sperm cells started). If she cannot find any sperm cells in that section she goes back to the lower part (closest to where the sperm cells started) and examines whether sperm cells have moved at all and if so, how far they have gotten. Maria explains that a normal sperm cell will be able to move about 40 to 60 millimeters. But that is not what happened in this case. To the contrary, the sperm cells have barely moved at all. And she would have to be very careful and precise when looking whether the sperm cells have "hidden somewhere", as she phrases it. Without looking up from the microscope, she says: "You can see that I am really concentrated. You have to look for every single cell." (Excerpt from fieldnotes)

So, what does good quality mean in this specific setting? All the work at the semen analysis lab is done in order to assure that a specific man will be able to father a child with a specific woman. A sperm cell is good enough if it is able to move through a woman's body in order to realize fertilization and thereby create a genetic relation between certain individuals. Here, the objective is to secure that certain people become parents by creating an environment that is as close as possible to fertilization due to heterosexual intercourse – the penetration test. Quality assessments are organized around this reproductive objective and based upon approximations and particular sets of measurements. A variety of important factors when assessing the quality of semen is not measured or accounted for, for example the state of sexual arousal at the time of ejaculation. Nevertheless, the outcome of the assessment is understood as a neutral and technical result, serving as the best possible and only available model to base medical treatment plans upon. And even if conception in principal takes only a single sperm and egg cell, and whilst it is unclear which sperm cells are most likely to fuse with egg cells after sexual intercourse, it is still tests for the number of sperm cells, their shape and their capacity to move that are used to assess semen's so-called quality. As we shall see when we now turn from the clinic for male fertility to the sperm bank, the indicators serving as 'measures' of good quality shift when the objective no longer is to find out what treatment plan a given couple should follow, but to select the right donor.

5. Sperm Donation: Semen Quality as Abundance

In contrast to the clinic where a minimum of vitality is good enough, the measurement of semen quality as part of sperm donation aims at max-

imum quality. Since sperm banks deal with semen samples that have an abundance of vitality (defined by most sperm banks as at least 200 million sperm cells per milliliter semen liquid), sperm banks need to establish standards in order to manage this abundance. As a consequence, the assessment of good quality at sperm banks includes additional measurements to those used in the context of male infertility. The objective of semen quality assessments at sperm banks is to screen for the best rather than treating the subfertile individual man or couple. Within the legal and state authorized frameworks set in place in Denmark (which, for example, exclude gay men from being sperm donors)[3], sperm banks thus undertake a detailed sorting of applicants guided by what staff at sperm banks deems to be indicators of 'good quality'. Sperm banks screen men as well as their semen: to identify good semen also means to find the good donor and vice versa. As previous research on sperm donors has shown, the performance of a particular kind of masculinity qualifies men – and therewith also their semen – as valuable within the biomedical context of sperm donation (Mohr 2010, 2014, 2016a, 2016b; Almeling 2011).

Once a man has made the decision to become a sperm donor, he will have to undergo a number of tests. While an initial assessment of men's semen based on similar tests for sperm count and motility as they are used in the clinic for male infertility verify that men pass the entry threshold of having an abundance of sperm cells, subsequent questionnaires relating to men's physical traits, their medical and genetic history, their family relations, their behavioural characteristics, and their personality are measures set into place to qualify that abundance. When sperm banks pose questions about illnesses and diseases, alcohol consumption, drug use, education and professional status, physical activity level, and sexual partners and promiscuity, the obvious goal is to rule out potential biogenetic factors that could pose a risk to a future child's health. But these assessments are also about more than just health. They contain ideas about who is suitable for reproduction and thus sort men according to specific personal characteristics that identify potential donors as socially acceptable. In order to do so, sperm banks rely on a negative list of characteristics including drug use, criminal behaviour, sexual promiscuity, and bi- and homosexuality, categories which – inside a biomedical logic – are all understood as indicators of risk behaviour and thus their absence as indicators of responsibility. When donors are asked to qualify themselves by answering different questionnaires, men are thus asked to identify themselves as belonging, or not, to certain *risk groups* with the effect that men are required to pass as 'responsible' when answering questions concerning health status, education, and sexual activity. In this way, the abstract ideal of responsibility becomes part of sperm banks' attempt to secure high quality semen, an extrapolation from the general to the particular that is both technically and normatively problematic (Mohr 2010).

Since responsibility is hard to measure on a scale from one to ten and therefore cannot only be captured in laboratory based assessments, do-

nors have to continuously *perform* responsibility as part of their interaction with sperm bank staff. One of the moments in which the performative dimension of responsibility is clearest is the screening interview potential sperm donors have to attend. These interviews are arranged after the applicant has delivered his first semen sample, and primarily serve the purpose of checking medical history. Verifying these so called 'facts' about their medical history in person is part of performing responsibility and takes place not just via verbal confirmation but also through the interaction between staff and donor:

> Stine now turns to the medical history: "I am assuming that you are well and healthy' she wants to know". "There has never been anything wrong with me", the donor replies. He then adds that his sister is overweight. Stine wants to know by how much. He explains that his sister would not have any problems in her daily life; she would just weigh more than other people. Looking at a piece of paper that contains information about his relatives, he answers all of Stine's questions. He also mentions that his mother has an allergy: "But neither my sister nor I have had any symptoms", he reassures Stine. His uncle has had heart problems: "But he was a drug and alcohol addict, so this was clearly due to his lifestyle", he concludes. As the interview is over, Stine and I talk about the donor candidate. "This was a typical interview", she says, "He didn't ask a lot of questions." But, Stine points out to me, what made this candidate special was the fact that he could actually answer all the questions in regards to his medical history: "He was very well prepared", she says, "and that reassures me that I can actually trust what a candidate says, which is always an advantage." (Excerpt from fieldnotes)

Men who want to be sperm donors thus have to perform responsibility, if not in their daily life then at least in situations in which they meet sperm bank staff. As the fieldnote demonstrates, coming forward with information relevant to one's medical history is part of performing responsibility. Also, pointing out that problematic health conditions are a result of irresponsible lifestyle rather than genetics construes the donor candidates as the responsible men that are sought after. Whereas good semen quality at the male fertility clinic was about finding enough vitality in order to determine a treatment plan, good semen quality at the sperm bank always already encompasses an abundance of vitality. Vitality, as an element of quality, thus operates differently at sperm banks. Here, vitality needs to be upgraded, as it were, through a number of social characteristics that the donors have to exhibit. These characteristics are partly thought of as travelling with sperm cells and partly as lowering the risk of potential illnesses and diseases. To assess quality at the sperm bank therefore means not only to evaluate each semen sample's observable characteristics, as in the male fertility clinic, but also involves the donors' lifestyles, personality, and sexuality. Good quality in the sperm bank embodies not only measurements of vitality, but also assessments of the personality of donors. These measurements are strikingly absent when we now move to the labs working with artificial sperm cells.

6. Articifical/in-vitro Sperm: Semen Quality as Proof of Principle

In 2003, germ cells of male mice were produced for the first time in-vitro, meaning outside of the animal body, with the help of a laboratory setting (Toyooka et al. 2003). This was followed by experiments with human tissue (Clark et al. 2009). In 2006, a German research team was able to create living mice offspring using in-vitro germ cells (Nayernia et al. 2006). As part of a publicly financed research project entitled *Germ Cell Potential*, some researchers from this team are continuing their research with tissue from subfertile men (Gromoll 2011). Social characteristics such as responsibility are not part of the quality assessment of in-vitro sperm; on the contrary, such characteristics are deemed utterly irrelevant by researchers. The primary goal is instead, as one researcher phrased it in an interview, "to get basic research as far as possible in order to secure that it can be used to cure male infertility at some point." Researchers imagine the production of in-vitro sperm as a solution to the cases of male infertility which the male fertility clinic cannot treat. Thereby their research can be read as an attempt to reify a kinship system which is based on the ideal of the nuclear family – father, mother, child – in which no "donor daddy" or "biological mother" interferes. Good quality sperm cells here are sperm cells from the *properly related* person. The quest to establish an unquestionable certainty, that genetic and social fatherhood reside in one and the same person, can, in other words, also be understood as an attempt to avoid the challenges to patriarchal kinship that donor insemination introduces.

If procreative cells can be created out of stem cells, a type of cell that everyone possesses, potentially anybody can become a "father". Sperm cells made from stem cells, what scientist themselves call in-vitro sperm, would not be found in semen anymore and, as a result, one of the central points of reference of a heteronormative gender order – the male-female dichotomy – would disappear[4]. While the queer implications of such research are obvious, they nevertheless do not appear to be the main driver of this research's agenda.

In comparison to the context of the male fertility clinic where the laboratory was acting as a stand-in for the female body, here the laboratory serves as a stand-in for the male body. The objective is to produce sperm cells that resemble the 'natural original' as much as possible, with the work which the male body accomplishes in order to produce sperm cells being imitated by researchers in the laboratory. In this setting, good quality sperm cells are primarily tied to a concept of purity. Cells have to be recognizable as 'pure' cells since they otherwise will be sorted out, a sorting practice which also manages the purity of the cell culture as a whole.

The culture mediums in which cells are grown are of utmost importance for this process as a researcher explained in an interview:

> The cells need to be cultivated within a certain time span in order to make sure that you have a pure culture. That means that I isolate the cells and place them in a medium and this medium needs to be changed, as far as I remember, after three days. Of course there will also be other cells in there, but they don't grow in the petri dish and that's why they can be washed out, so that just those stem cells which actually have the potential to grow further will stay in the dish. (Excerpt from interview)

Securing a pure culture of cells with the help of a specific medium and through particular working practices can be understood as an attempt to imitate the process in the male body through which sperm cells are produced as part of spermatogenesis. Stem cells in testicles turn into sperm cells via a chain of different developmental stages and splitting phases, imitated in the lab by successive changes of the medium and by washing out unwanted cells. The purity of the cells and culture – absence of bacteria, presence of specific proteins – is an important quality criterion. Semen quality is therewith tied to an idea of purity that is believed to be found in the healthy, that is, fertile man. But just as the definitive healthy man does not exist, neither does the ultimately pure culture. In the interviews, researchers described problems they have trying to cultivate a pure cell culture:

> A big problem is of course the contamination of cell cultures. That happens all the time, either when bacteria come in during times when everybody has a cold, someone sneezes while the incubator is open, that kind of stuff. That is a typical problem. Or when the cells which are supposed to be used for spermatogenesis do not express the expected phenotype. (Excerpt from interview)

The ideal of natural purity is not so easy to reach, and even its approximation requires researchers to repeatedly intervene in the developmental processes that take place in the petri dish.

The culture mediums thus guarantee the growth of the desired cells which helps researchers to identify the right cells. After the cells have grown successfully, researchers rely on protein markers that signal which cells have reached a certain state. Most experiments use fluorescent markers, which attach to the specific proteins of interest, meaning that "good" cells will light up under fluorescent light. The sorting of "good" cells from "bad" cells is done by an automated device, echoing the ejaculation of whole, mature sperm cells by the male body.

The ultimate proof of success in creating good sperm cells is to show that they can produce offspring, as another researcher explained in an interview:

Mohr: "What does having a good cell mean for you?"
Researcher: "That is not so important for us. We are interested in how we get most of the cells successfully through meiosis, how we can raise the number of haploid cells. But proof of principle is of course that we should find out if the cells can fertilize or not, if we can get living animals out of them." (Excerpt from interview)

Surviving offspring in these experiments is a sign of *good enough* quality, in contrast to the quality assessments at sperm banks. But a different set of approximations is used for this assessment than when subreproductive sperm samples are assessed at the male fertility clinic.

Whereas the goal of sperm donation is to create children with desired traits (and absence of disease), it is the genetic relationship between certain animals that is of importance in the context of in-vitro sperm. The objective is to be able to say for sure who is father to whom instead of father to what. Sperm cells do not need to be of excellent quality in order to be good enough, just as it is the case at the male fertility clinic. The deciding criterion is that an unwanted intervention in heteronormative kinship can be avoided. Queer kinship relations remain only a future, unintended consequence should new users adopt the technology. Semen quality in in-vitro research shifts from being an intrinsic quality of cells into a constructed quality. In the course of this construction, the very word "sperm cell" seems to change its meaning: it is not so much an entity any longer, but rather a capacity, an action, namely to fertilize and reproduce. It changes its associations from a noun to verb, we might say, with the gender and 'fatherhood' attached to artificial germ cells becoming the result of a historic precedence rather than that of a social identity assigned to the body from which the cells originate. That which makes the cells good depends on the laboratory's ability to produce and identify certain markers which mark the cells as good cells. In the broadest sense, all this is set in place in order to be able to control *who* is related genetically to whom.

7. Conclusions

By definition, quality reflects values and thus will always depend on subjective assessments. By comparing three different contexts in which the quality of semen is assessed, we have shown that these assessments reflect norms and desires which some people have in common and others not and which those involved – medical professionals, patients, sperm banks staff, sperm donors, or researchers – only seldom consciously and autonomously choose or dismiss. In other words, whilst these norms and desires surrounding reproduction and genetic relatedness shape measurements with very concrete effects, they are seen as not worth discussing in the clinical or research context. In this way, semen quality is made to

appear as a purely "technical" matter used as background data when making the "real" normative decisions about who gets to reproduce and in which ways. We have shown, in contrast, that norms are not just added at some later point when treatment decisions are made but go to the core of the medical judgment.

We have presented three different ways in which sperm cells can be identified as being of good quality, reflecting different goals and implicitly associated values. A sperm cell can be good enough if it is able to move through a woman's body in order to realize fertilization and thereby create a genetic relation between certain individuals, as seen in the context of subreproductive semen. Here, the objective is to secure that certain people become parents by testing sperm cells in an environment that is as close as possible to heterosexual intercourse. A sperm cell can also be good, if it has an abundance of vitality, as is the case in sperm donation. Here, however, sperm donors are also assessed, and personal characteristics become a deciding factor when assessing if a man's semen is good enough. Last but not least, a sperm cell can be good, if it has the capacity to perform a certain function, namely to fertilize, as is the case with in-vitro sperm. Here the cell as an entity is no longer important. It is not heterosexual intercourse that needs to be recreated but rather the developmental processes within the male body, the objective being to control and minimize interventions in specific kin relations.

Though public debates use and refer to semen quality as an unquestionable technical fact, most bio-analysts, clinic staff, and researchers are aware that the standards they employ rely on approximations. Measurements are made in order to support decisions – be they treatment plans or interventions in petri dishes. When moving across the three different fields of subreproductive semen, sperm donation, and in-vitro sperm it becomes apparent that what 'good quality' means is very much dependent on context. In fact, the whole idea of a sperm cell being a phenomenon which is just out there with measurable qualities becomes increasingly unconvincing when one moves across the different contexts. When we look at semen and examine it, the way we look at it and from which perspective will be decisive for what we will define as a problem and what we will think is appropriate to solve it. Normative choices are part of this process, even when measurements are framed as "just" quality assessments. Determining semen quality means to decide and plan who gets to have children with whom, and exploring, changing, and negotiating what semen is, and what it can do, means also structuring future family, kinship, and gender relations.

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[1] It is important to note that the term "fertility" carries different meanings in different contexts. In popular discourse and debate, it is typically used to describe a man's ability to have children. In the andrological literature, fertility means that a man has actually had children. The potentiality embedded in the popular understanding of fertility is instead referred to as "fecundity" within andrology. For communication purposes, we follow the popular usage.

[2] Biomedical interventions like IVF or ICSI are often referred to as treatments within the clinical settings of reproductive biomedicine. While these treatments also represent a particular medicalization of reproduction in general and the female and male body in particular, the sense making of the use of reproductive technologies also involves the (de)stabilization of gender identities, that is, while

some women and men undergoing fertility treatment experience closure in the sense that they become women and men through the successful birth of a child, others come to realize the boundaries of their gendered selfhood and the pain that this might entail due to not being able to have children (Franklin 1997; Tjørnhøj-Thomsen 2009; Inhorn 2012). Our usage of the term treatment here tries to capture this dynamic, the potency of reproductive technologies "to constitute gender identities in which imaginations about, and norms pertaining to, what it means to be a woman or a man are linked with the idea of the good citizen as a reproductive citizen, someone who pursues having children as a collectively shared ideal." (Mohr and Koch 2016, 93).

[3] The legal document states that men who have had sex with men should be excluded, unlike in Spain and Great Britain – both countries of the European Union. The Danish authorities based the guidelines for sperm donation on those regulating blood donation, grounded in the assumption that men who have sex with men have a higher risk of HIV infection. This risk is thought of as being present no matter the actual behavior of an individual man. Sperm donors are thus selected based on their sexual preference rather than on their actual risk behavior.

[4] It should be noted that the production of offspring using only genetically female tissue and cells is more difficult. As researchers interviewed during fieldwork explained, cells with two X-chromosomes have difficulties getting further than meiosis, a critical developmental stage in the production of germ cells.